Watershed: **Tuolumne River**

Years Sampled: **2007-2008, 2010-2014**

Study Objectives:

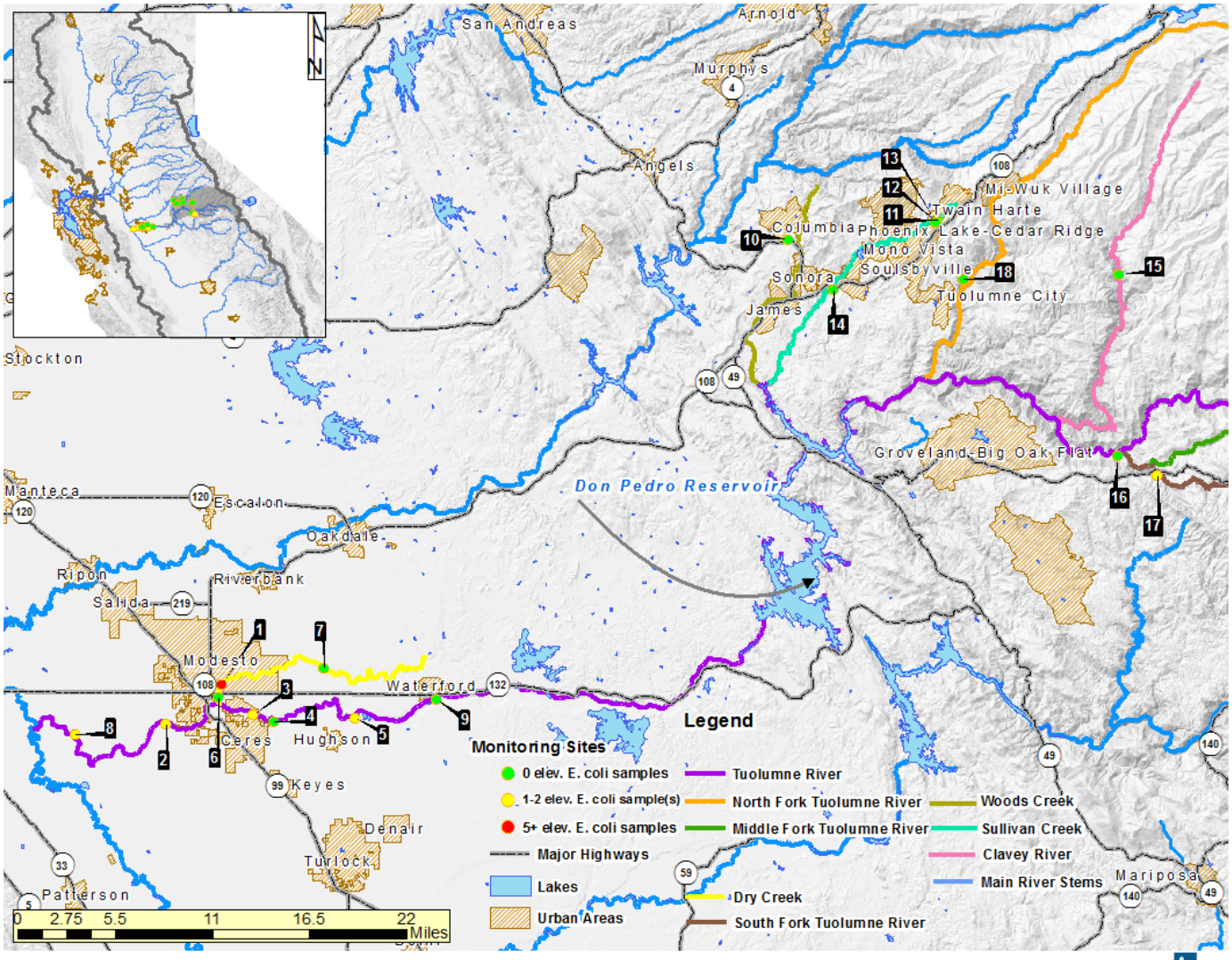
1. Is there any evidence that beneficial uses are being impacted, and if so, what are potential contributors?
2. Are there any noticeable regional, seasonal or trends observed in the water quality data?
3. What are pathogen concentrations at selected monitoring sites?

KEY STATISTICS

Number of sites sampled	**17**
Sampled by	**Water Board Staff (Sac)**
	Tuolumne River Trust
Number of sites sampled for pathogens	**7**
Number of total samples	**216**
Sampling Frequency	**2x/mo. (May-Sept.)**
Assessment Threshold	**320 MPN/100 mL**

Message: **Seven sites have had one or more samples with elevated *E.coli* and five sites have tested positive for pathogens. Ten sites never exceeded the assessment threshold.**

Site Locations:



Summary of Results:

Table 1: Field Measurements

Station Code	Map #	Station Name	Oxygen, Dissolved (mg/L)		pH		SpConductivity (uS/cm)		Temperatiure (˚C)		Turbidity (NTU)	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
535STC206	1	Dry Creek at La Loma Road	2.96	10.80	6.82	8.63	70.0	140.0	18.89	26.40	7.86	20.80
535STC215	2	TR at Audie Peeples (Riverdale) Fishing Access	5.70	13.00	6.80	10.02	40.0	210.0	14.40	32.40	1.87	5.22
535STC216	3	TR at Legion Park	3.54	14.48	7.50	10.05	40.0	190.0	15.00	29.80	0.75	3.52
535STC217	4	TR at Ceres River Bluff Park	7.40	8.63	7.00	11.08	40.0	180.0	14.40	34.80	1.02	4.89
535STC218	5	TR at Fox Grove	7.09	17.60	7.37	11.75	30.0	190.0	12.80	29.60	0.72	3.56
535STC220	6	Dry Creek at Beard Brook Park	8.25	8.52	7.42	7.65	107.0	120.0	19.35	22.20	12.30	16.40
535STC221	7	Dry Creek at Wellsford Road	7.96	8.25	7.27	7.35	96.0	102.0	19.52	19.56	16.30	17.90
535STC513	8	TR at Shiloh Fishing Access	6.54	16.20	6.80	8.78	40.0	280.0	14.40	32.50	0.55	6.66
535TR5xxx	9	TR at Waterford Road	7.05	7.97	7.43	8.97	30.0	70.0	13.00	29.60	0.26	11.20
536TUO201	10	TR at Crystal Falls	8.01	8.01	8.12	8.30	105.0	200.0	21.14	25.40	1.58	8.60
536TUO210	11	Twain Harte Lake at Lakeview Drive	NR	NR	NR	NR	NR	NR	21.20	21.20	NR	NR
536TUO211	12	Twain Harte Lake at Mono Drive	7.30	11.29	8.04	9.39	15.0	133.0	18.52	25.22	1.38	2.93
536TUO212	13	Twain Harte Lake at Dam	NR	NR	NR	NR	NR	NR	21.30	21.30	NR	NR
536TUO230	14	Sullivan Creek at Elsies Pool	7.10	7.10	8.15	8.15	70.0	70.0	17.10	17.10	1.07	1.07
536TUO301	15	Clavey River at Gods Bath	8.94	9.48	7.58	9.65	38.0	59.0	14.13	16.26	0.14	0.26
536TUO302	16	TR at Meryls Pool	8.50	10.93	6.90	7.90	14.3	81.0	10.44	21.80	0.20	8.57
536TUO900	17	TR, South Fork at Rainbow Pools	7.66	10.87	7.29	8.01	15.0	107.8	9.38	23.47	0.16	6.11
536TUO901	18	TR, North Fork at Riverside Day Use Area	5.60	5.60	7.70	7.70	90.0	90.0	14.90	14.90	0.39	0.39

TR: Tuolumne River, NR: Not Recorded

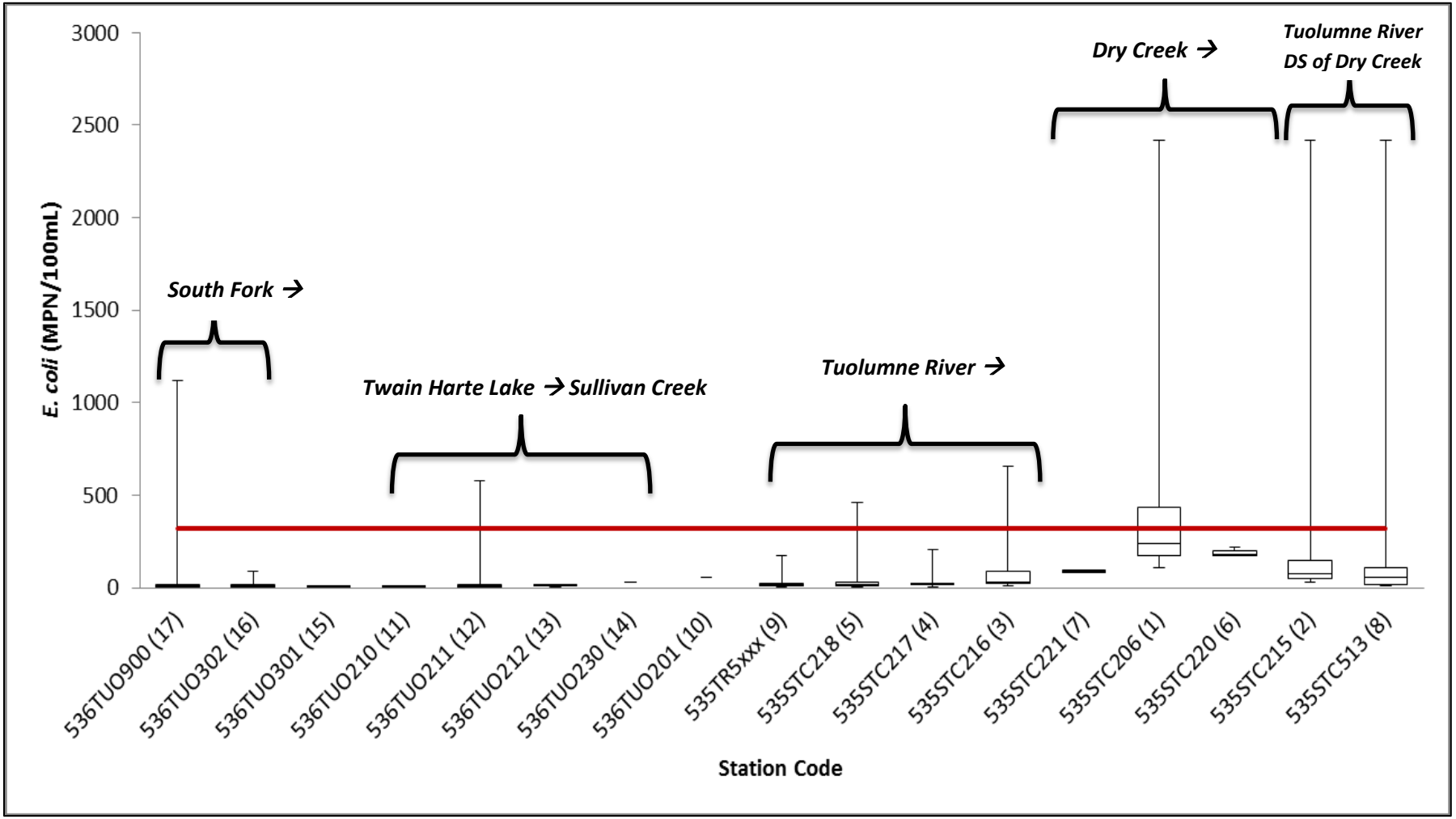
Table 2: *E. coli* and Pathogen Results

Map #	*E. coli* (MPN/100ml)					*Cryptosporidium* (cysts/L)			*Giardia* (oocysts/L)			*Salmonella* (MPN/100mL)			*E.Coli* O157:H7 (Presence/Absence)		
	Mean	Min	Max	Count	>320	Max Result	Count	(+)	Max Result	Count	(+)	Max Result	Count	(+)	Result	Count	(+)
1	426.2	108.1	2419.6	17	5	Not Detected	1	0	0.842	1	1	Not Detected	1	0	Not Detected	1	0
2	256.0	27.2	2419.6	15	1	Not Detected	1	0	0.222	1	1	Not Detected	1	0	Not Detected	1	0
3	89.3	12.1	653.9	15	1	Not Detected	1	0	Not Detected	1	0	Not Detected	1	0	Not Detected	1	0
4	32.6	5.2	204.6	15	0	Not Detected	1	0	0.293	1	1	Not Detected	1	0	Not Detected	1	0
5	42.5	1.0	461.1	21	1	0.258	7	2	0.129	7	1	0.055	7	2	Not Detected	7	0
6	189.8	172.2	218.7	3	0	NA	0	0	NA	0	0	NA	0	0	NA	0	0
7	86.3	81.6	90.9	2	0	NA	0	0	NA	0	0	NA	0	0	NA	0	0
8	224.2	10.8	2419.6	17	2	Not Detected	1	0	Not Detected	1	0	Not Detected	1	0	Not Detected	1	0
9	31.5	4.1	172.3	14	0	Not Detected	1	0	0.195	1	1	Not Detected	1	0	Not Detected	1	0
10	56.3	56.3	56.3	1	0	NA	0	0	NA	0	0	NA	0	0	NA	0	0
11	3.5	1.0	6.3	5	0	NA	0	0	NA	0	0	NA	0	0	NA	0	0
12	62.5	<1.0	579.4	12	1	NA	0	0	NA	0	0	NA	0	0	NA	0	0
13	7.1	6.3	7.5	3	0	NA	0	0	NA	0	0	NA	0	0	NA	0	0
14	29.8	29.8	29.8	1	0	NA	0	0	NA	0	0	NA	0	0	NA	0	0
15	3.9	1.0	8.6	3	0	NA	0	0	NA	0	0	NA	0	0	NA	0	0
16	19.5	2.0	90.8	9	0	NA	0	0	NA	0	0	NA	0	0	NA	0	0
17	112.3	1.0	1120.0	11	1	NA	0	0	NA	0	0	NA	0	0	NA	0	0
18	NR	NR	NR	0	0	NA	0	0	NA	0	0	NA	0	0	NA	0	0

E.coli - NR: Not Recorded, Highlighted Cells: Exceeds EPA Guidline of 320 MPN/100ml

Pathogens - (+): positive result, Highlighted Cells: positive results, NA: Not Applicable

Graph 1: *E Coli* Results



17,16 = progressive DS flow along South Fork; 11,12,13,14 = progressive DS flow from shorelines along Twain Harte Lake (11,12,13) to Sullivan Creek (14);
9,5,4,3 = progressive DS flow along Tuolumne River (above Dry Creek confluence in Modesto);
7,1,6 = progressive DS flow along Dry Creek; 2,8 = progressive DS flow along Tuolumne River (below Dry Creek confluence)

WHAT IS THE MEASURE SHOWING?

Known for its whitewater rafting and scenic valleys, the Tuolumne River flows from Yosemite National Park down into the Central Valley; it feeds the Don Pedro Reservoir and, eventually, the San Joaquin River west of Modesto. In the foothills, it collects drainage from various tributaries, including Woods Creek, Sullivan Creek, and Clavey River. Within Modesto, Dry Creek empties into the main stem. The sites in the Tuolumne watershed are located throughout Sonora and Modesto. The easternmost sites, near Groveland-Big Oak Flat, are on the South Fork Tuolumne River. The northernmost sites are on the Clavey River, North Fork Tuolumne, and Sullivan Creek which all surround Sonora. The westernmost sites surround Modesto along the Tuolumne River. Field measurements for each site are shown in Table 1.

Results show that eight sites exhibited elevated levels of *E. coli* in the Tuolumne watershed on one or more occasions (shown in Table 2). There were 12 samples with elevated levels out of 164 samples, or 7.3%. The highest concentration (>2419.6MPN/100 mL) occurred at three different sites; two of these sites are located on the Tuolumne River downstream from Modesto (2,8), and the other site is located along Dry Creek at La Loma Road (1). Dry Creek at La Loma Road (1) also exhibits an average result above the recommended EPA guideline (320 MPN/100 mL). While there were detections at eight sites (shown in Graph 1), their occurrences were few relative to the sample count. Detections upstream of the Dry Creek-Tuolumne River confluence were rare.

The watershed is primarily forest (Jin et al., 2013), yet potential non-point and urban sources are abundant. It is heavily utilized for recreational activities, and is home to numerous waterfowl and other wildlife. Further study is needed to identify specific sources.

Seven sites in the Tuolumne watershed were sampled for pathogenic *E. coli* O157:H7, *Cryptosporidium*, *Giardia*, and *Salmonella*. Five of the sites tested positive for pathogens (shown in Table 2). There are currently no water quality objectives for these constituents.

WHY THIS INFORMATION IS IMPORTANT?

In 2012, the USEPA amended recreational water quality guidelines for human health under the Clean Water Act, specifying the standard threshold value (STV) for the indicator bacteria *E. coli* as 320 colony-forming units (CFU) per 100 milliliters (mL). The STV represents the 90% percentile of the water quality distribution, beyond which the water body is not recommended for recreation (Nappier & Tracy, 2012).

E. coli is an indicator of potential fecal contamination and risk of illness for those exposed to water (e.g. when swimming). Since *E. coli* is only an indicator of potential pathogens and does not necessarily identify an immediate health concern, the data collected from this study provide more information on pathogen indicators as well as specific water-borne pathogen concentrations to better assess their impact on the beneficial use of recreation and to identify potential contributors by sub watershed.

WHAT FACTORS INFLUENCE THE MEASURE?

E. coli and specific water-borne pathogens can come from human or animal waste and may be highly mobile and variable in flowing streams. In addition to human recreational use, the presence of pathogens in water may be the result of cattle grazing, wildlife, urban and agricultural runoff, or sewage spills. The physical condition of the watershed may also influence pathogen measurements, however in this study field measurements (temperature, SC, DO, turbidity and pH) were variable between sites and it is unclear if these constituents had an effect on the *E. coli* or pathogen measurements.

TECHNICAL CONSIDERATIONS:

- Data available at: CEDEN
- *E. coli* is only an indicator of potential pathogens and does not necessarily identify an immediate health concern.
- Public reports and fact sheets are available at: http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_studies/surface_water_ambient_monitoring/swamp_regionwide_activities/index.shtml

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